

ORACLE
DATABASE **11g**

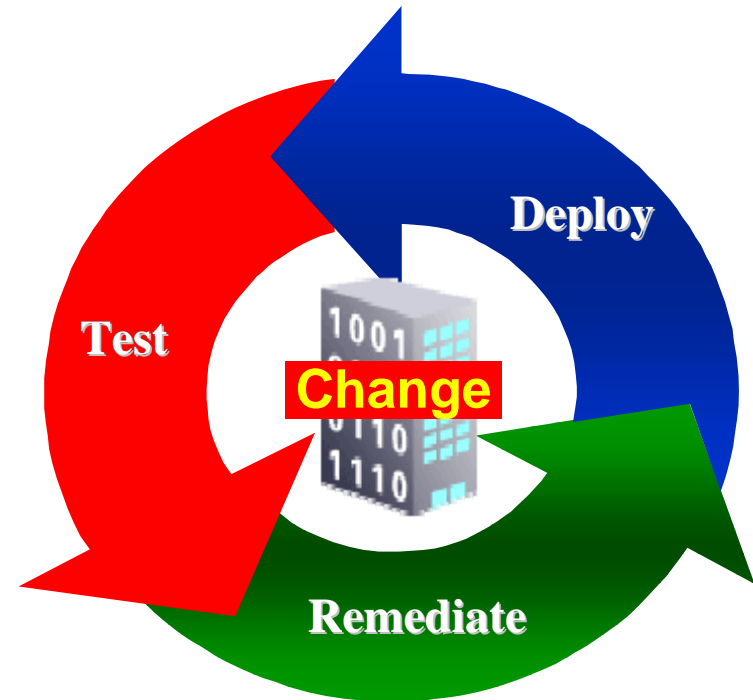


Oracle Database 11g Real Application Testing: Introducing **Database Replay** and **SQL Performance Analyzer**

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Real Application Testing

- Features
 - Database Replay
 - SQL Performance Analyzer
- Value
 - Rapid technology adoption
 - Higher testing quality
- Business Benefit
 - Lower cost
 - Lower risk



Solution for the Agile Business

Database Replay

The Need for Database Replay

- Businesses want to adopt new technology that adds value
- Extensive testing and validation is expensive in time and cost
- Despite expensive testing success rate low
 - Many issues go undetected
 - System availability and performance negatively impacted
- Cause of low success rate
 - Current tools provide inadequate testing
 - Simulate synthetic workload instead of replaying actual production workload
 - Provide partial workflow coverage



Database Replay makes real-world testing possible

Database Replay

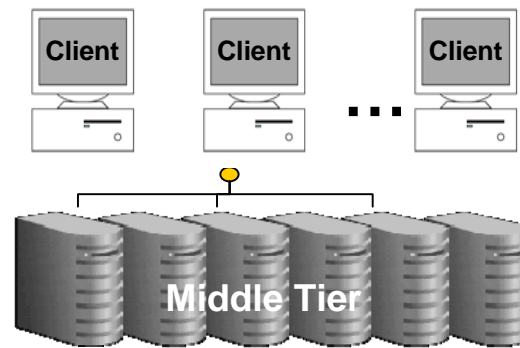
- Replay actual production database workload in test environment
- Identify, analyze and fix potential instabilities before making changes to production
- **Capture Workload in Production**
 - Capture full production workload with real load, timing & concurrency characteristics
 - Move the captured workload to test system
- **Replay Workload in Test**
 - Make the desired changes in test system
 - Replay workload with full production characteristics
 - Honor commit ordering
- **Analyze & Report**
 - Errors
 - Data divergence
 - Performance divergence



Analysis & Reporting

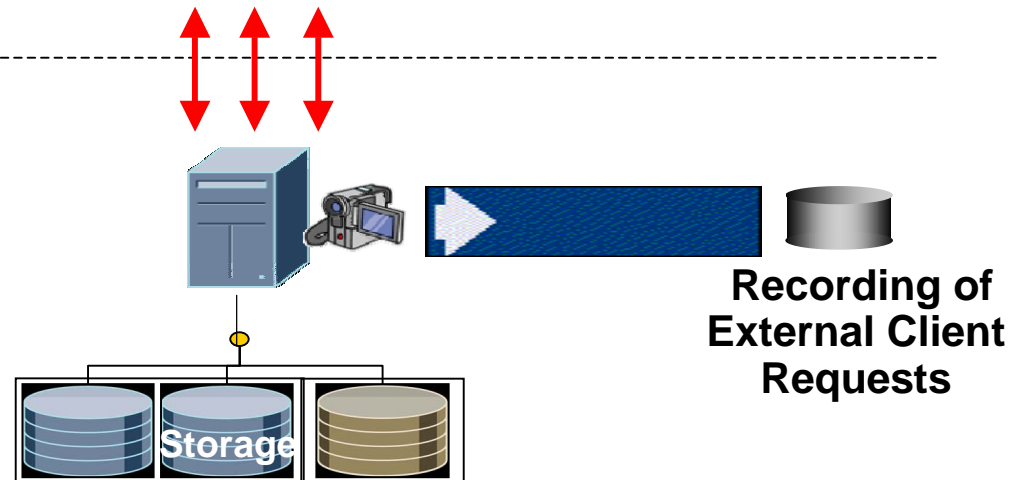
Database Replay: Supported Changes

Changes
Unsupported



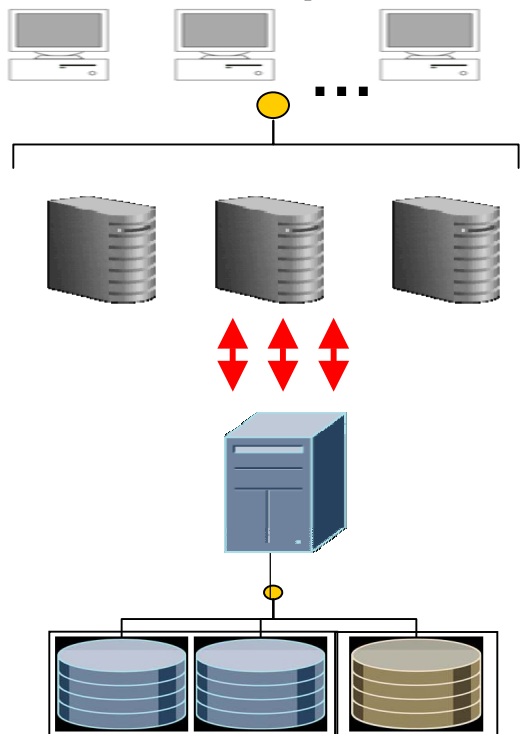
Changes Supported

- Database Upgrades, Patches
 - Schema, Parameters
- RAC nodes, Interconnect
- OS Platforms, OS Upgrades
 - CPU, Memory
 - Storage
- Etc.

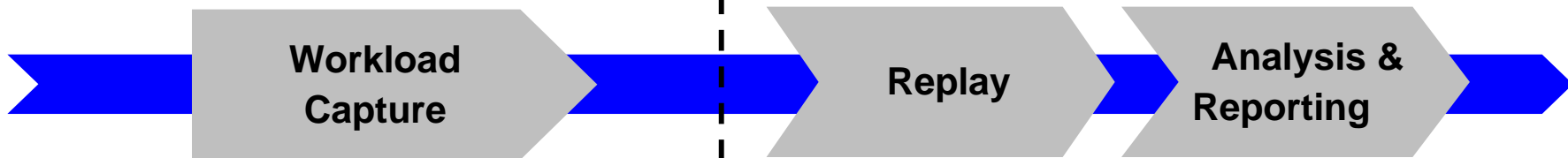
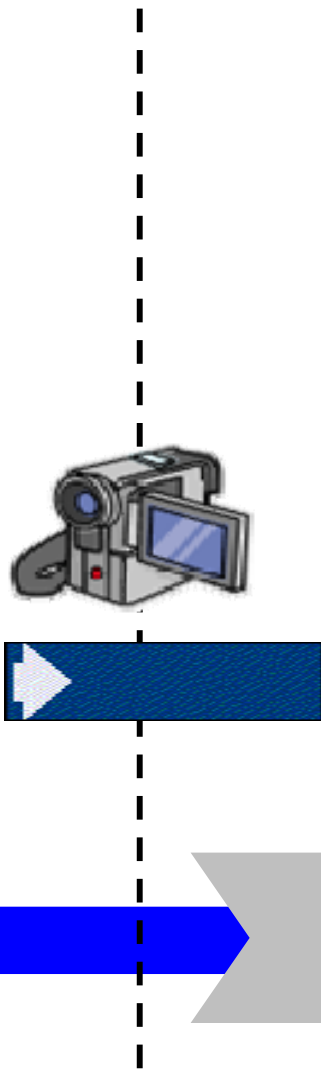
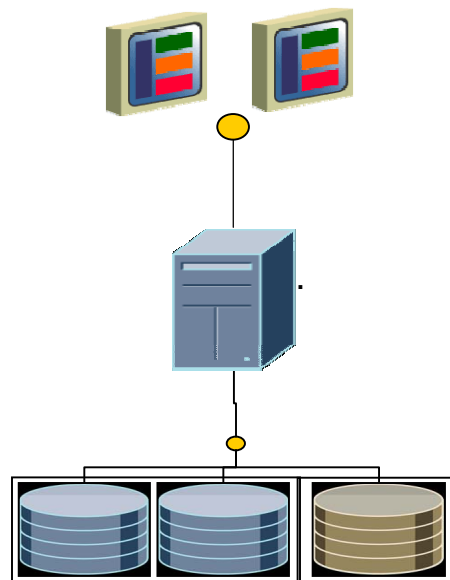


Database Replay Workflow

Production (10.2.0.4)

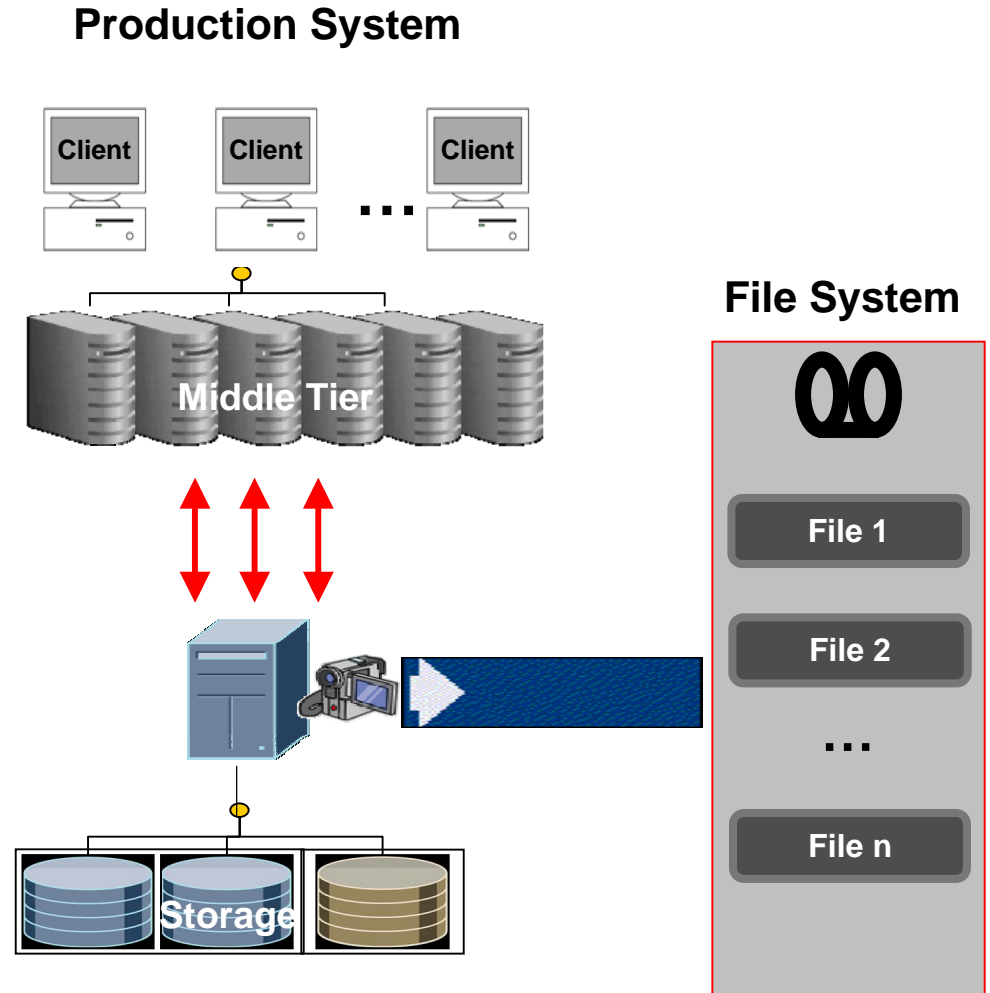


Test (11.1)



Workload Capture

- All external client requests captured in binary files
- System background, internal activity excluded
- Minimal performance overhead for capture
- For RAC, shared and local file system supported
- Specify interesting time period for capture, e.g., peak workload, month-end processing, etc.

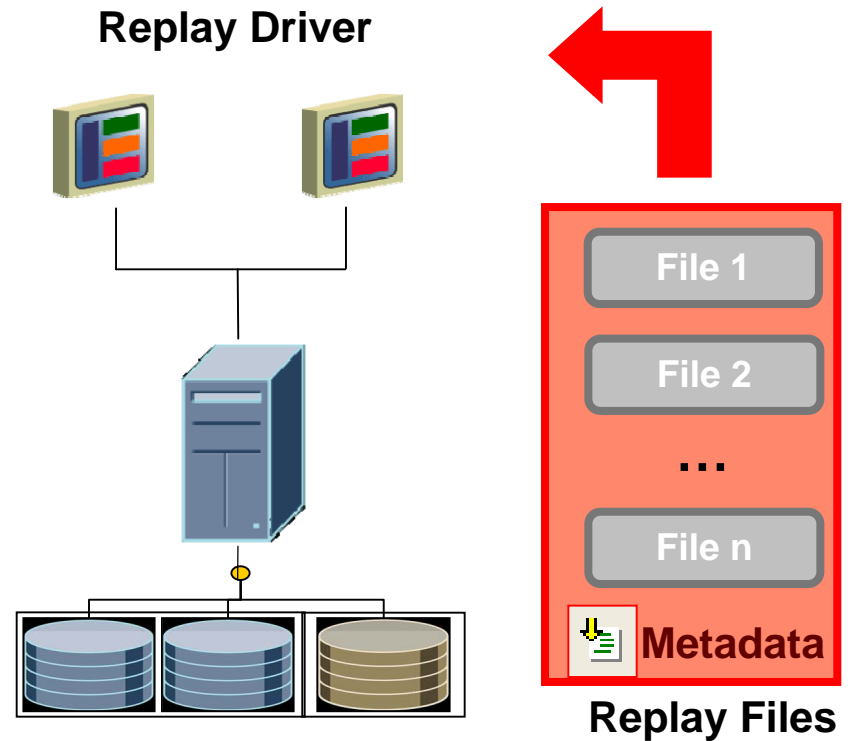


Workload Capture: Options

- Workload can be filtered to customize what is captured
 - Filter Types
 - Inclusion Filters: Specifies which sessions should be captured
 - Exclusion Filters: Specifies which sessions should NOT be captured
 - Filter Attributes: Workload capture can be filtered using any of the following session attributes
 - User
 - Program
 - Module
 - Action
 - Service
 - Session ID
- Workload capture can be run on-demand or scheduled to run at later time

Workload Replay

- Replays workload preserving timing, concurrency and dependencies of the capture system
- Replay Driver is a special client program that consumes processed workload and sends requests to the replay system
- Replay Driver consists of one or more clients. For workloads with high concurrency, it may be necessary to start multiple clients to drive workload



Workload Replay: Options

- Synchronized Replay
 - Workload is replayed in full synchronized mode
 - Exact same concurrency and timing as production workload
 - Transaction commit order is honored
 - Ensures minimal data divergence
- Unsynchronized Replay
 - Workload can be replayed in unsynchronized mode
 - Useful for load/stress testing
 - Three (3) parameters provided to control degree of synchronization
 - Think time synchronization
 - Commit order synchronization
 - Connect (logon) time synchronization

Analysis & Reporting

- Comprehensive reports are provided for analysis purposes
- There (3) types of divergences are reported
 - **Data Divergence**: Number of rows returned by each call are compared and divergences reported
 - **Error Divergence**: For each call error divergence is reported
 - New: Error encountered during replay not seen during capture
 - Not Found: Error encountered during capture not seen during replay
 - Mutated: Different error produced in replay than during capture
 - **Performance Divergence**
 - Capture and Replay Report: Provides high-level performance information
 - ADDM Report: Provides in-depth performance analysis
 - AWR, ASH Report: Facilitates comparative or skew analysis



Database Replay Summary Report

Database Instance: database > Database Replay > Logged in As SYS
 View Workload Replay: REPLAY3 OK

Status **Completed**

Summary

Replay Name	REPLAY3	Capture Name	CAPTURE3
Directory Object	GP1	Duration (hh:mm:ss)	00:03:02
Database Name	V12	Prepare Time	Apr 13, 2007 4:46:46 PM PDT
DBID	1623065897	Start Time	Apr 13, 2007 4:48:32 PM PDT
Replay Error Code	N/A	End Time	Apr 13, 2007 4:51:34 PM PDT
Replay Error Message	None		

Workload Profile | [Detailed Comparison](#) | [Connections](#) | [Replay Parameters](#) | [Report](#)

Elapsed Time Comparison

Category	Elapsed Time (Minutes)
Capture	~3.6
Replay	~3.0

Assessing the Replay

The Elapsed Time Comparison chart shows how much time the replayed workload has taken to accomplish the same amount of work as captured.

When the replay bar is shorter than the capture bar then the replay environment is processing the workload faster than the capture environment.

The divergence table gives information about both the data and error discrepancies between the replay and capture environments, which can be used as a measure of the replay quality.

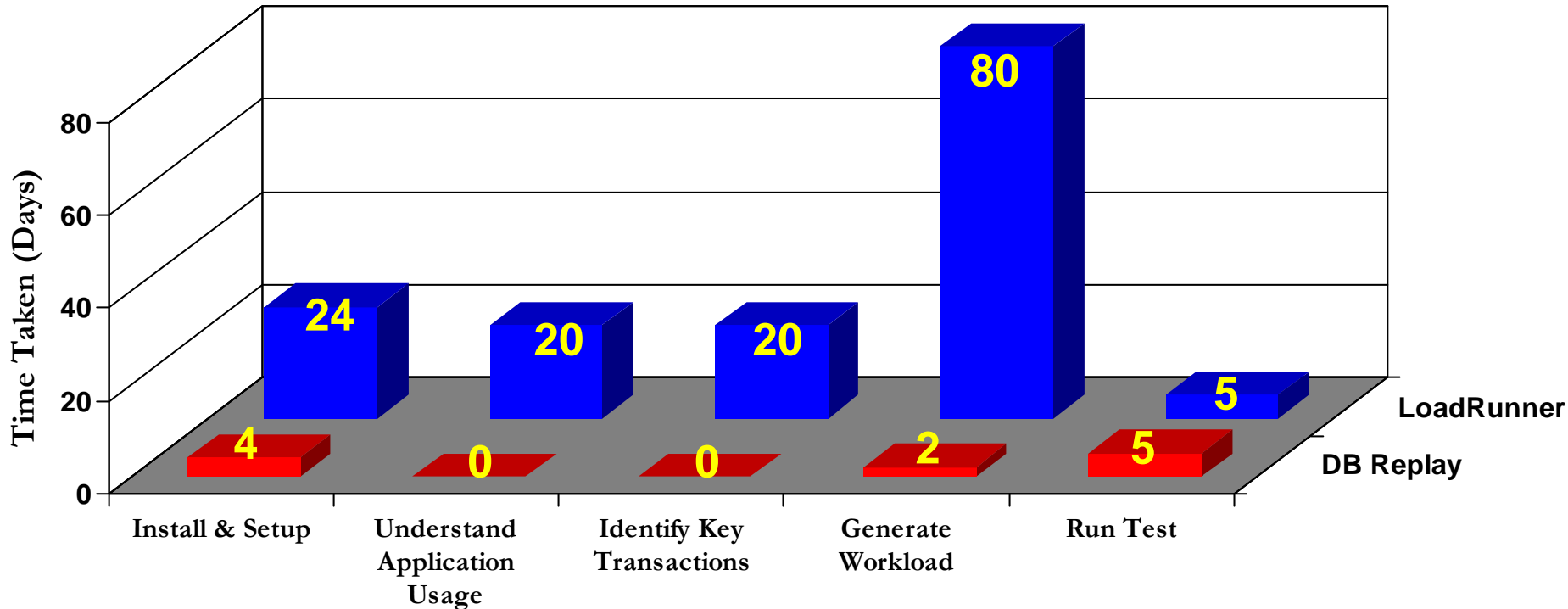
[View Workload Replay Report](#)

Divergence

	Calls	Percentage of Total
Capture Errors Not in Replay	0	0.00
Capture Errors Mutated in Replay	0	0.00
Capture Errors Not Replayed	0	0.00
Replay Errors Not in Capture	0	0.00
DML Rows Modified	0	0.00
Query Rows Fetched	0	0.00

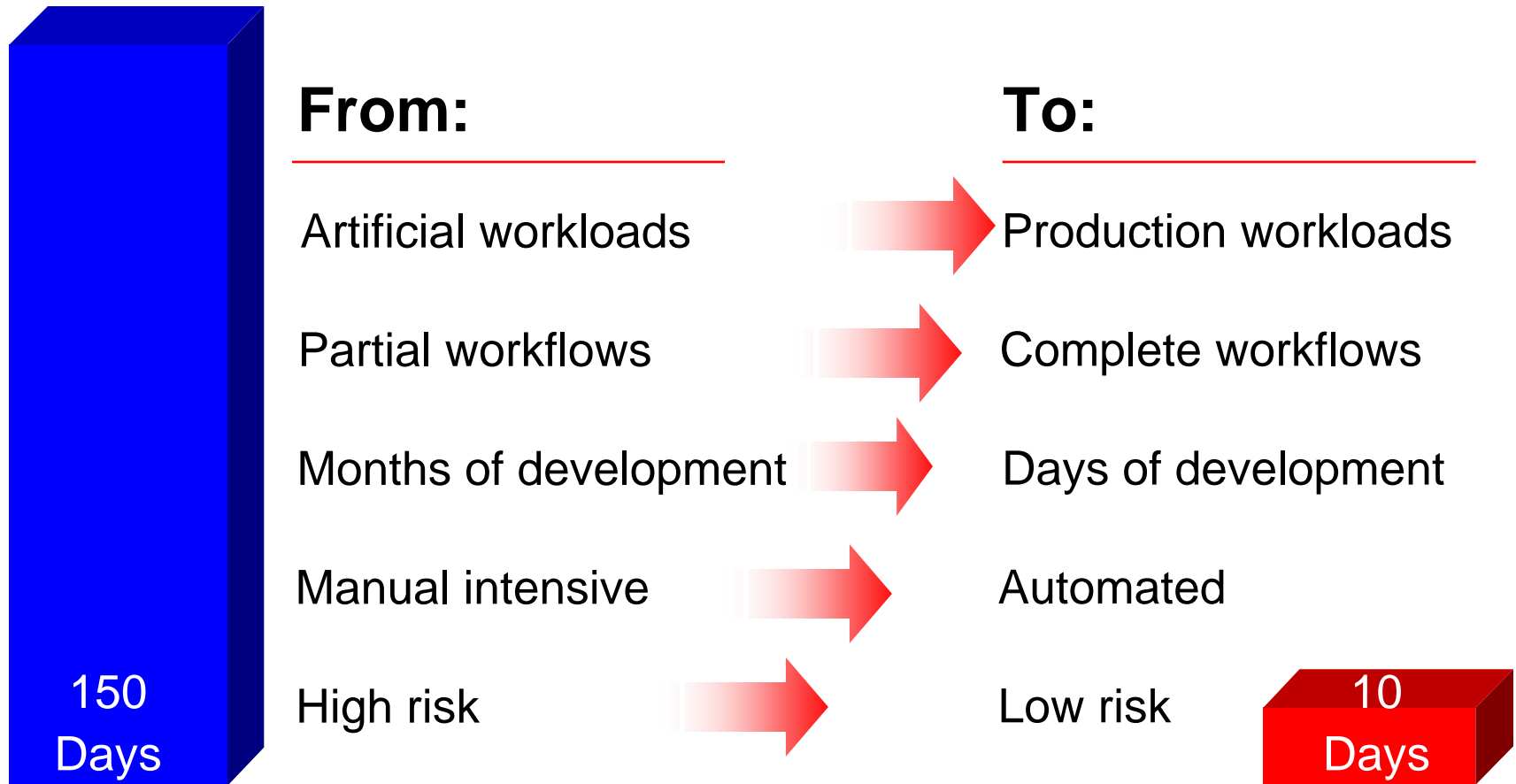
Traditional Load Testing vs. Database Replay

E-Business Suite Comparison



Total Testing Time
DB Replay: 2 weeks
LoadRunner: 30 weeks

Why Database Replay?

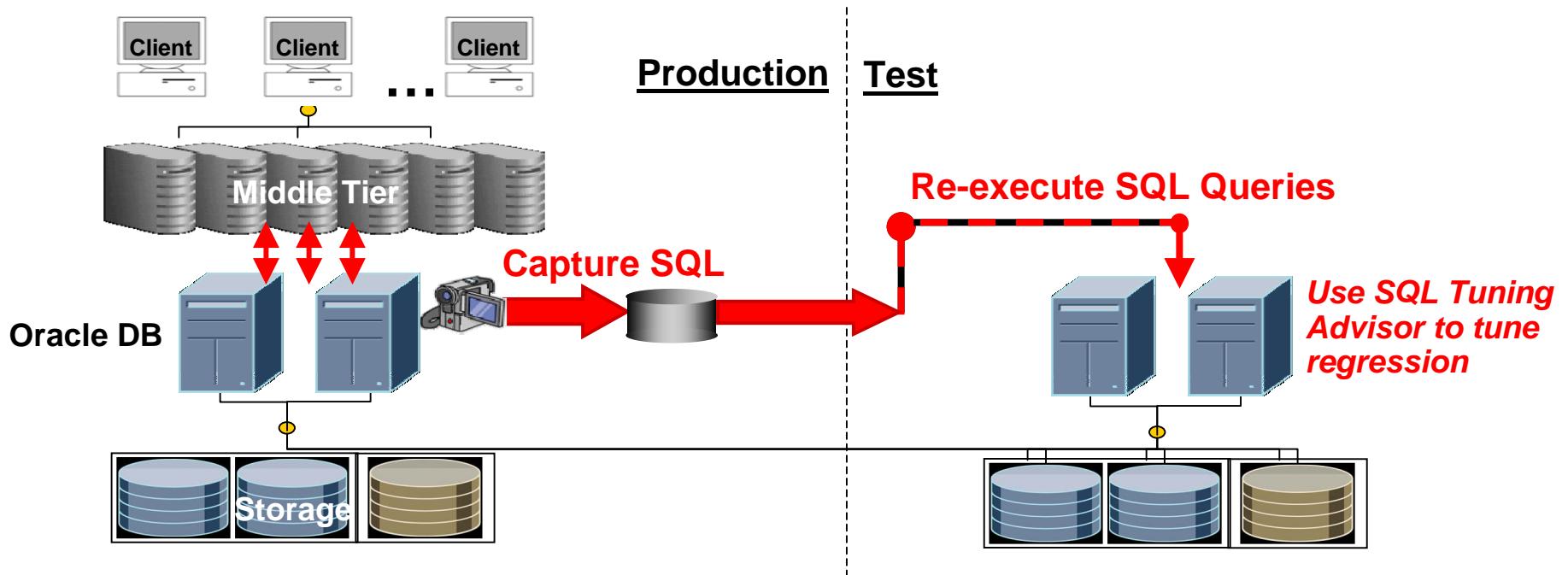




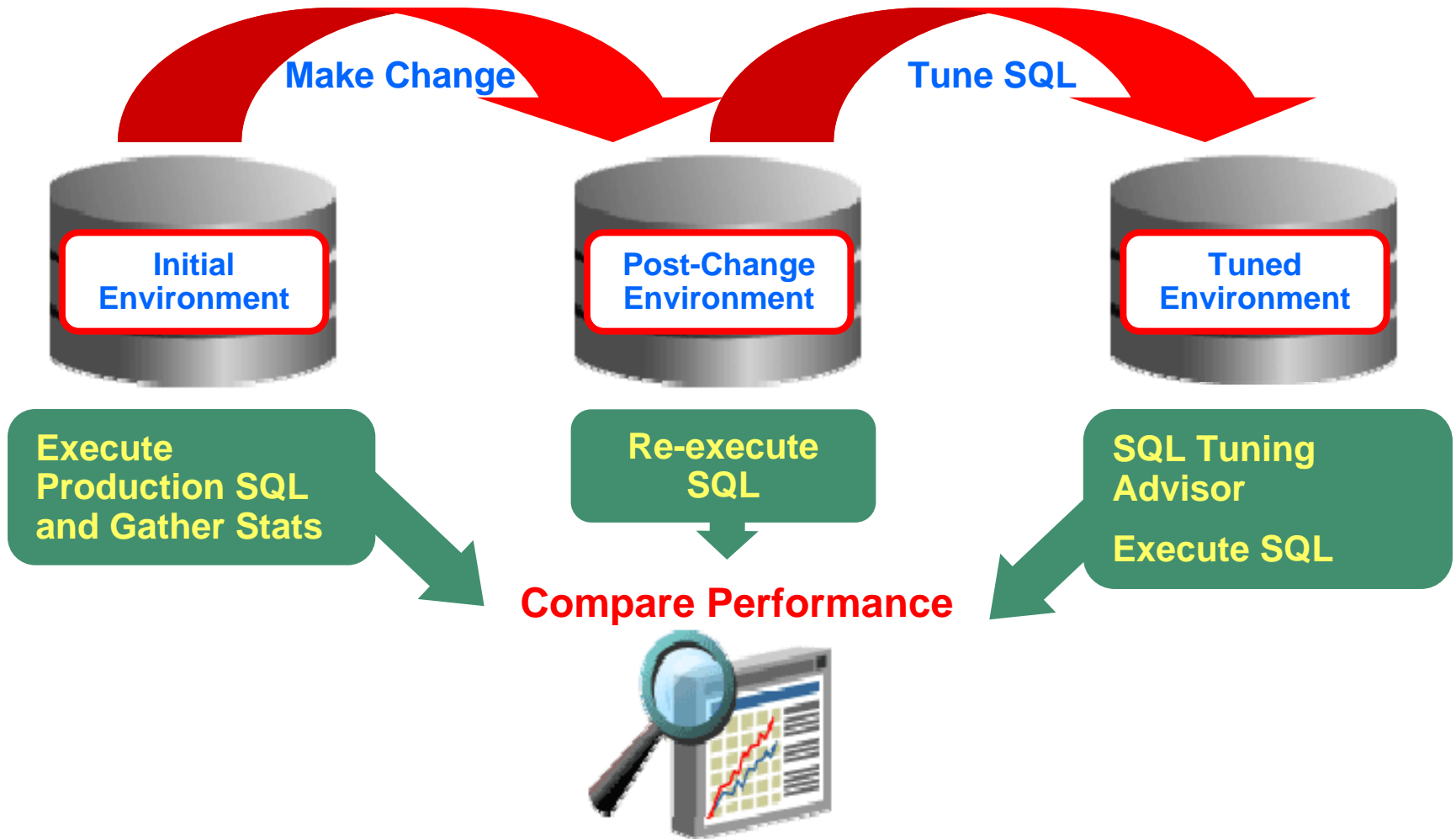
SQL Performance Analyzer (SPA)

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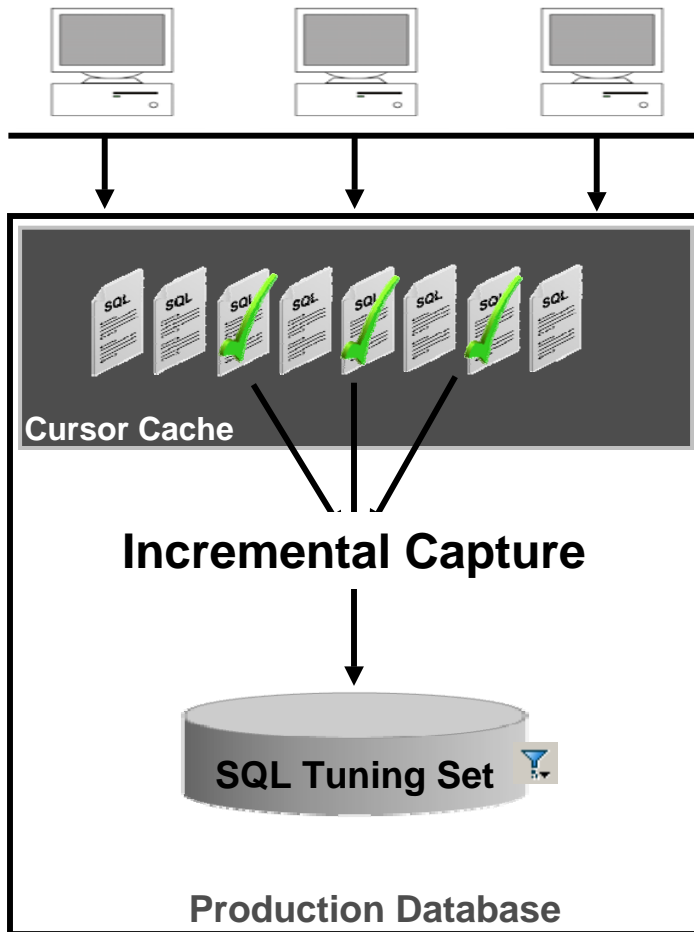
- Test impact of change on SQL query performance
- Capture SQL workload in production including statistics & bind variables
- Re-execute SQL queries in test environment



SPA Workflow

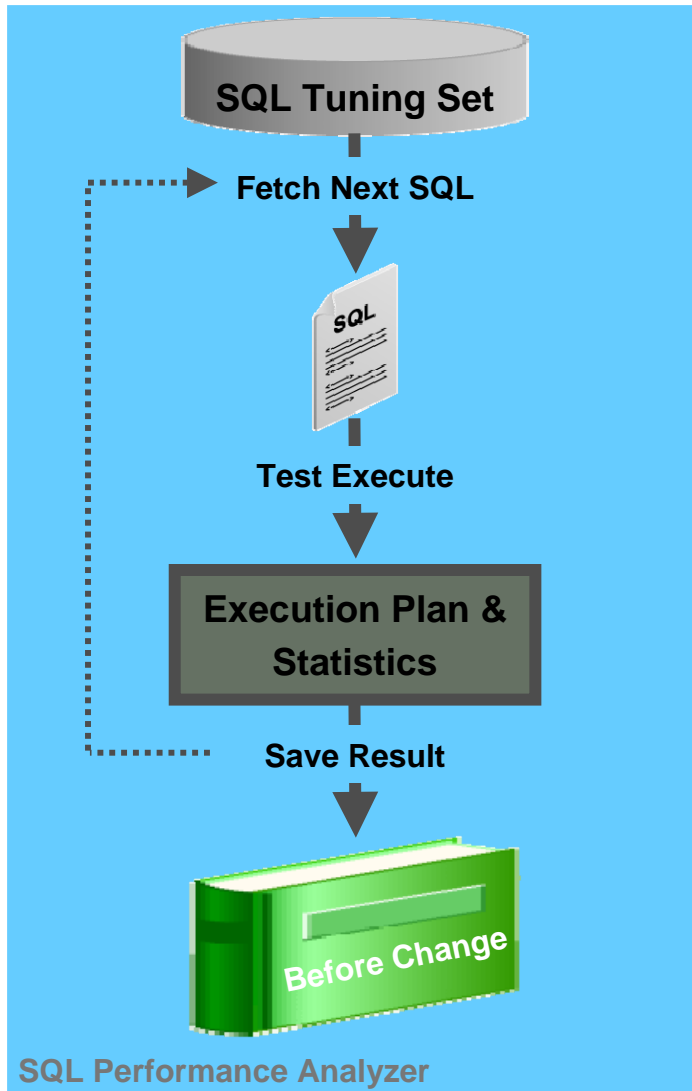


Capture SQL Workload from Production



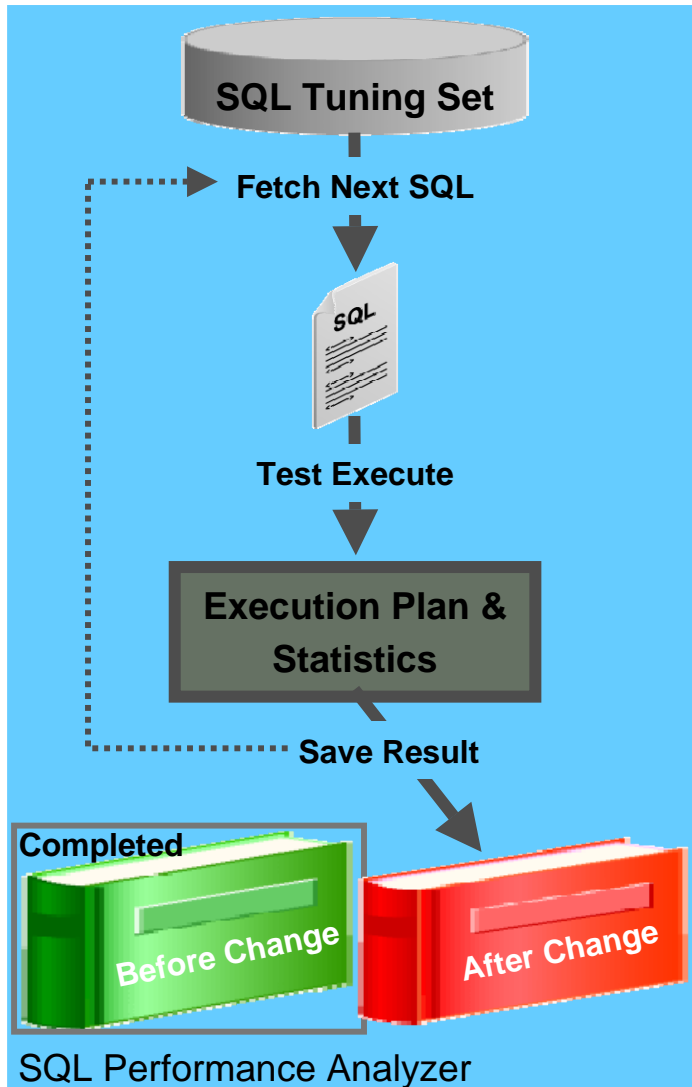
- **SQL Tuning Set (STS)** used to capture SQL workload
- **STS includes:**
 - **SQL Text**
 - **Bind variables**
 - **Execution plans**
 - **Execution statistics**
- **Incremental capture** used to populate STS from cursor cache over a time period
- **SQL tuning set's filtering and ranking capabilities** filters out undesirable SQL
- **Transportable STS** used to move workload to test system

Execute SQL Before Making Change



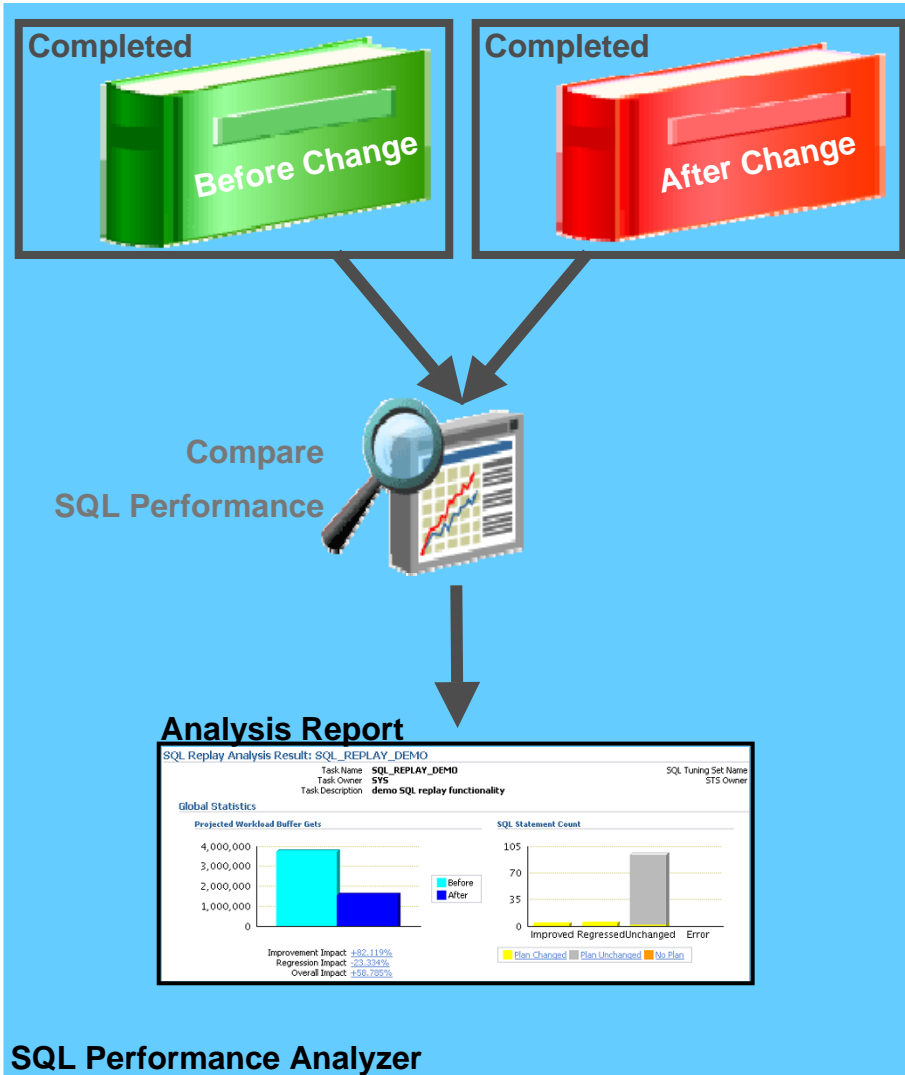
- Establishes SQL workload performance baseline
- SQL execution plan and statistics captured
- SQL executed serially (no concurrency)
- Each SQL executed only once
- DDL/DML skipped
- Option to do Explain Plan only analysis

Execute SQL After Making Change



- **Manually implement the planned change:**
 - Database upgrade, patches
 - Optimizer statistics refresh
 - Schema changes
 - Database parameter changes
 - Tuning actions, e.g., SQL Profile creation
- **Re-execute SQL after change**
 - Gathers new SQL execution plans and statistics

Compare & Analyze Performance



- Compare performance using different metrics, e.g.,
 - Elapsed Time
 - CPU Time
 - Optimizer Cost
 - Buffer Gets
- SPA Report shows impact of change for each SQL
 - Improved SQL
 - Regressed SQL
 - Unchanged SQL
 - SQL with Errors
- Fix regressed SQL using SQL Tuning Advisor or SQL Plan Baselines

SPA Report

SQL Performance Analyzer Task Result: SYS.SYSTEMCHANGES1

Task Name **SYSTEMCHANGES1**
 Task Owner **SYS**

SQL Tuning Set Name [HR_WORKLOAD](#)
 STS Owner **APPS**

Replay Trial 1 **Before**
 Replay Trial 2 **After**

Task Description

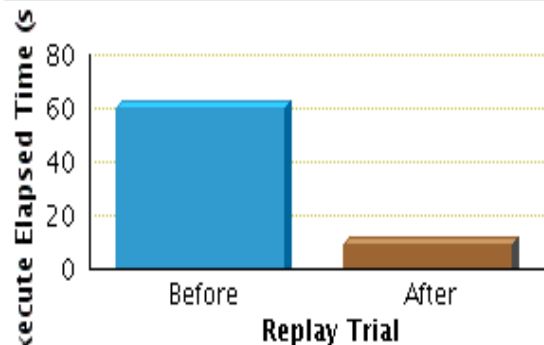
Total SQL Statements **50**

Comparison Metric **Execute Elapsed Time**

SQL Statements With Errors [0](#)

Global Statistics

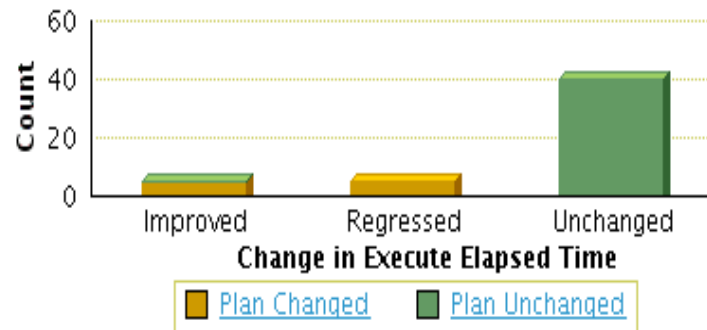
Projected Workload Execute Elapsed Time



Improvement Impact [89%](#) ↑
 Regression Impact [-5%](#) ↓

Overall Impact [85%](#) ↑

SQL Statement Count



Recommendations

Run SQL Tuning Advisor to tune regressed SQL statements.

[Schedule SQL Tuning Advisor](#)

SPA Benefits

- Enables identification of SQL performance regressions before end-users can be impacted
- SPA can help with any change that impacts SQL execution plan
 - DB upgrades
 - Optimizer statistics refresh
 - New indexes, Materialized Views, Partitions, etc.
- Automates SQL performance tracking of hundreds of thousands of SQL statements – impossible to do manually
- Captures SQL workload with low overhead
- Integrated with SQL Tuning Advisor and SQL Plan Baselines for regression remediation

O & *A*